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Cancer burden and clinical presentation at Sebha Oncology Centre, Libya: A comparative study of urban and rural patient populations

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Keywords: Cancer epidemiology, clinical presentation, disparity of cancer services, treatment migration

Abstract: Cancer represents a growing public health burden in Libya, yet epidemiological data remain limited. The absence of comprehensive cancer registries has resulted in a fragmented understanding of disease patterns and treatment practices. This study aimed to describe the demographic characteristics, clinical presentations, and patterns of chemotherapy utilization among cancer patients attending Sebha Oncology Centre, the sole specialized oncology facility serving southern Libya. A retrospective descriptive study was conducted at Sebha Oncology Centre. Medical records of patients diagnosed and managed between January 2020 and December 2021 were reviewed. Of 309 screened records, 110 met the inclusion criteria and were analyzed. Data extracted included sociodemographic characteristics, cancer type, stage at diagnosis, metastatic status, and treatment modalities. Associations between residence and clinical variables were assessed using Fisher's Exact Test with effect sizes measured by Cramér's V. The average age of patients was 51.39 years, with 62.7% aged between 41 and 64 years. Females constituted the majority of the cohort. Breast cancer was the most prevalent malignancy (42.7%), followed by prostate (12.7%) and colorectal cancers (8.2%). Most patients were diagnosed at Stage II (70.9%), and 36.4% presented with metastatic disease. A significant association was found between stage at diagnosis and place of residence, showing that patients from outside Sebha are more likely to present at Stage II. Chemotherapy was the primary treatment modality (80.0%), while surgical and radiotherapy options remained limited. Cancer patients at Sebha Oncology Centre are predominantly middle-aged females, reflecting the high burden of breast cancer. A significant disparity exists in the stage at diagnosis based on geographic residence. The heavy reliance on chemotherapy underscores infrastructure limitations in surgery and radiotherapy. These findings highlight the urgent need for early detection programs, improved oncology infrastructure in Libya, and enhanced healthcare access for rural populations.

Introduction

Cancer incidence and mortality demonstrate substantial geographic variation worldwide [1]. Although high-income countries (HICs) report higher overall cancer incidence rates, low- and middle-income countries (LMICs) bear a disproportionately greater burden of cancer-related mortality. In LMICs, mortality rates remain high and continue to rise, in contrast to the declining or stabilizing trends observed in many HICs [2]. This disparity is

largely attributed to delayed diagnosis, limited access to treatment, inadequate screening programs, and fragile healthcare systems. Furthermore, the true burden of cancer in LMICs may be underestimated due to the absence of comprehensive cancer registries and robust surveillance systems [3]. Thus, projections indicate a continued increase in cancer incidence across developing regions, including North Africa and the Middle East [2]. In Libya, cancer represents a growing public health challenge, exacerbated by demographic transition, an aging population, and constrained healthcare infrastructure. Despite its clinical and societal impact, the epidemiological profile of cancer in Libya remains insufficiently characterized. Available evidence is sparse and fragmented, largely derived from hospital-based reports rather than population-based cancer registries. Previous institutional studies from Tripoli Medical Centre and Benghazi Medical Centre provided preliminary insights but are limited by methodological constraints, including reliance on hospital registry data and inclusion of patients from broad catchment areas, which restricts the accuracy of incidence estimation and limits generalizability [4, 5]. Additional regional reports have similarly focused on western and eastern Libya, creating a geographic imbalance in available data [6, 7]. Southern Libya remains substantially under-investigated. Given the scarcity of epidemiological data from this region, there is a critical need to characterize the demographic and clinical features of cancer patients receiving care in southern Libya. The Sebha Oncology Centre (SOC) serves as the sole specialized oncology facility in the southern region, making it a valuable source of regional clinical data. Accordingly, this study aimed to characterize the demographic profiles, clinical presentations, and patterns of chemotherapy utilization among cancer patients attending the SOC. Furthermore, it sought to compare clinical characteristics and treatment modalities between residents of Sebha City and those in surrounding rural areas to identify potential geographic disparities in cancer care. By providing structured evidence from this underserved region, these findings also aim to inform national oncology planning, strengthen regional cancer control strategies, and provide a data-driven foundation for healthcare policy development within the Libyan health system.

Materials and methods

Study design and setting: This study employed a retrospective descriptive design conducted at the SOC, the only specialized oncology referral facility serving southern Libya. SOC provides cancer diagnostic and treatment services to patients covering an estimated population of about 500,000. Because of its central role in oncology care in the region, SOC is the source of cancer-related clinical data in southern Libya.

Study sampling: All medical records of patients diagnosed with cancer and managed at SOC between January 1, 2020, and December 31, 2021, were screened for eligibility. During this period, a total of 309 patient records were identified. After applying predefined inclusion and exclusion criteria, 110 patient records were deemed eligible in the final analysis.

Eligibility criteria: Patients of all ages and sexes were eligible for inclusion if they had a confirmed cancer, either histopathologically or clinically documented, and if their medical records contained complete and essential demographic, clinical, and therapeutic information. Medical records were excluded if data elements were missing, including cancer stage, metastatic status, or treatment modality, or if the diagnosis of malignancy was not clearly confirmed in the medical file.

Data collection: Data were collected between April and September 2025 through a systematic review of archived medical records and chemotherapy treatment registries at SOC. A self-structured data form was prepared to ensure consistency and completeness of data extraction. The variables included sociodemographic characteristics (age at diagnosis, gender, and place of residence classified as urban or rural), clinical characteristics (type of primary cancer, stage at diagnosis, metastatic status, and presence of comorbid conditions), and therapeutic information (treatment modality and specific chemotherapeutic, hormonal, or targeted agents administered).

Ethical considerations: Written authorization to conduct the study was obtained from the SOC committee following an official request from the Faculty of Pharmacy, Sebha University, Sebha (SU-02-2025). All patient identifiers were removed during data extraction to maintain confidentiality, as this study involved a retrospective review of existing medical records; informed consent was waived. All data were handled in accordance with the ethical standards, and strict confidentiality was maintained throughout the study.

Statistical analysis: Descriptive analysis summarized the cohort characteristics, with continuous variables (age) expressed as mean ± standard deviation. For comparative analysis, age was categorized into four groups (<20, 21-40, 41-64, and >65 years). To assess the impact of geographic location on clinical outcomes, the study population was stratified into two groups: residents of Sebha city (urban) and those from outside Sebha (rural/outer areas). The associations between residence and categorical variables-including age groups, gender, cancer types, stages, and treatment modalities-were evaluated using the Pearson chi-square test. However, if more than 20% of the expected cell frequencies were less than five, Fisher's Exact Test was employed to ensure statistical rigor. For all significant associations, the effect size was determined using Cramér's V. A p-value of <0.05 was established as the threshold for statistical significance.

Results

Demographic characteristics: A total of 110 cancer patients met the inclusion criteria and were included in the final analysis. Of these, 41.8% patients were residents of Sebha City, while 58.2% patients resided outside Sebha (**Table 1**). The mean age of patients was 51.39 ± 14.13 years (range: <20 to >65 years). The majority of patients were aged 41-64 years (62.7%, 95% CI: 53.6%-71.1%), followed by patients aged >65 years (20.0%, 95% CI: 13.4%-28.5%). Patients aged 21-40 years represented 16.4% (95% CI: 10.6%-24.4%), while one patient (0.9%, 95% CI: 0.02%-4.9%) was younger than 20 years. There was no significant difference in age distribution between patients from Sebha and those from outside Sebha (χ^2 test, p=0.338) (**Table 1**). Females constituted 66.4% (95% CI: 57.0%-74.8%) of the study population, while males accounted for 33.6% (95% CI: 25.2%-43.0%). The female-to-male ratio was around 2: 1. No significant association was observed between gender and place of residence (χ^2 test, p=0.831) (**Table 1**). Most patients had no documented comorbidities (84.4%) (95% CI: 76.2%-90.3%). One comorbidity was reported in 11.9% (95% CI: 6.8%-19.7%), while multiple comorbidities were present in 3.7% (95% CI: 1.2%-9.2%). The difference in comorbidity distribution between Sebha and non-Sebha patients did not reach the significance level (χ^2 test, p=0.095) (**Table 1**).

Table 1: Demographic and comorbidities data of Libyan patients attending the Sebha Oncology Center

Variable	Sebha	Outside Sebha	Frequency (%)	P value
Age; 51.39 ± 14.13				**0.338**
< 20	00 (0.0)	01 (1.6)	01 (0.9)	
21-40	08 (17.4)	10 (15.6)	18 (16.4)	
41-64	26 (56.5)	43 (67.2)	69 (62.7)	
> 65	12 (26.1)	10 (15.6)	22 (20.0)	
Total	**46 (41.8)**	**64 (58.2)**	**110 (100)**	
Gender				**0.831**
Male	16 (34.8)	21 (32.8)	37 (33.6)	
Female	30 (65.2)	43 (67.2)	73 (66.4)	
Total	**46 (41.8)**	**64 (58.2)**	**110 (100)**	
Comorbidities				**0.095**
No comorbidity	35 (76.1)	57 (90.5)	92 (84.4)	
One comorbidity	09 (19.6)	04 (06.3)	13 (11.9)	
More comorbidity	02 (04.3)	02 (03.2)	04 (03.7)	
Total	**46 (41.8)**	**64 (58.2)**	**110 (100)**	

Cancer type: Breast cancer was the most prevalent malignancy, accounting for 42.7% of cases (95% CI: 33.6%-52.3%). Prostate cancer was the second most common, 12.7% (95% CI: 7.6%-20.5%), followed by colorectal cancer, 8.2% (95% CI: 4.4%-14.8%), lymphoma, 7.3% (95% CI: 3.7%-13.7%), and leukemia, 6.4% (95% CI: 3.1%-12.7%). Lung cancer and cervical cancer each represented 2.7% (95% CI: 0.9%-7.7%), while pancreatic cancer accounted for 1.8% (95% CI: 0.3%-6.9%). The "other" cancer category comprised 15.5% (95% CI: 9.9%-23.5%), including bladder, thyroid, testicular, and liver cancer (**Table 2**). The distribution of cancer types showed a near-significant difference between residents of Sebha and those from outside the city (Fisher's Exact test =14.12, p = 0.058). Remarkably, in **Table 2**, all reported cases of lung cancer occurred among Sebha residents (6.5%), whereas a higher diversity of 'other' cancer types was observed in patients originating from outside Sebha (23.4%).

Table 2: Clinical presentation of cancer patients attending the Sebha Oncology Centre

Variable	Sebha	Outside Sebha	Frequency (%)	p-value
Cancer types				**0.058**
Breast	20 (43.5)	27 (42.2)	47 (42.7)	
Prostate	08 (17.4)	06 (09.4)	14 (12.7)	
Lung	03 (06.5)	0.0 (00.0)	03 (02.7)	
Colorectal	03 (06.5)	06 (09.4)	09 (08.2)	
pancreatic	01 (02.2)	01 (01.6)	02 (01.8)	
Leukemia	05 (10.9)	02 (03.1)	07 (06.4)	
Lymphoma	03 (06.5)	05 (07.8)	08 (07.3)	
Cervix	01 (02.2)	02 (03.1)	03 (02.7)	
Others	02 (04.3)	15 (23.4)	17 (15.5)	
Total	**46(41.8)**	**64 (58.2)**	**110 (100)**	
Cancer stages				**0.038**
Unknown	02 (4.3)	04 (6.2)	06 (5.5)	
Stage 1	00 (0.0)	01 (1.6)	01 (0.9)	
Stage 2	29 (63)	49 (76.6)	78 (70.9)	
Stage 3	09 (19.6)	06 (9.4)	15 (13.6)	
Stage 4	06 (13.0)	04 (6.2)	10 (9.1)	
Total	**46 (41.8)**	**64 (58.2)**	**110 (100)**	
Metastasis				**0.443**
Unknown	02 (4.3)	06 (9.4)	08 (7.27)	
Un-metastasis	26 (56.5)	36 (56.2)	62 (56.3)	
metastasis	18 (39.1)	22 (34.3)	40 (36.4)	
Total	**46(41.8)**	**64(58.2)**	**110(100)**	

Cancer stage at diagnosis: Stage II was the predominant stage, observed in 70.9% of patients (95% CI: 61.8%-78.6%). Stage III disease was reported in 13.6% (95% CI: 8.4%-21.2%), and Stage IV in 9.1% (95% CI: 5.0%-15.9%). One patient (0.9%) was diagnosed at Stage I. Stage was undocumented in 5.5% (95% CI: 2.5%-11.5%) (**Table 2**). A significant association was identified between the cancer stage at diagnosis and the patient's place of residence (p=0.046 by Fisher's Exact test). Patients residing outside Sebha were more frequently diagnosed at Stage II (76.6%) compared to those living within the city (63.0%). This association confirmed a small-to-moderate effect size (Cramér's V = 0.24), suggesting that geographic location may have a role in the timing of clinical presentation. Regarding the metastatic status, while 56.4% (95% CI: 47.2%-65.2%) had non-metastatic cancer, the metastatic status remained undocumented in a small minority of cases (7.3%). Statistical analysis revealed no significant association between metastatic status and place of residence (Fisher's Exact test, p=0.781). Comparable proportions of metastatic disease were observed between urban and rural residents, suggesting that geographic location did not significantly influence the likelihood of presenting with advanced metastatic spread in this cohort (**Table 2**).

Treatment modalities: In **Table 3**, Chemotherapy was the predominant treatment modality, administered to 80.0% of the cohort (88; 95% CI: 71.4%-86.6%). Surgery followed by chemotherapy was utilized in 9.1% of cases (95% CI: 5.0%-15.9%), while combined chemotherapy and radiotherapy was administered to 6.4% (95% CI: 3.1%-12.7%). Surgery as a monotherapy was reported in 3.6% (95% CI: 1.4%-8.9%), and one patient (0.9%) received a multimodal approach consisting of surgery, chemotherapy, and radiotherapy. Statistical analysis revealed no significant disparity in treatment patterns between residents of Sebha and those from outside the city (Fisher's Exact test, p=0.783). Chemotherapy remained the primary intervention for both groups, involving 80.4% of Sebha residents and 79.7% of patients from outer regions. These findings reflect a uniform treatment pattern across the cohort, suggesting that therapeutic decisions were consistent regardless of the patients' geographic origin.

Table 3: Pattern of cancer therapy approaches for Libyan patients attending Sebha Oncology Centre

Variable	Sebha	Outside Sebha	Frequency (%)	p-value
Treatment types				**0.94**
Chemotherapy	37 (80.4)	51 (79.7)	88 (80)	
Chemotherapy + Radiotherapy	02 (04.3)	05 (7.8)	07 (6.4)	
Surgery	01 (02.2)	03 (4.7)	04 (3.6)	
Surgery + chemotherapy	05 (10.9)	05 (7.8)	10 (9.1)	
Surgery+ chemotherapy + radiotherapy	01 (02.2)	0.0 (0.0)	01 (0.9)	

Pattern of chemotherapy drugs: In **Table 4**, among chemotherapeutic agents prescribed, 5-Fluorouracil was the most frequently used, followed by Docetaxel, Goserelin, and Carboplatin. Cyclophosphamide, Dexamethasone, and Letrozole were each prescribed to nine patients. Additional drugs included Epirubicin, Oxaliplatin, and Capecitabine, Paclitaxel and Trastuzumab, and Tamoxifen. Targeted therapies such as Bevacizumab, Bortezomib, and Imatinib were used in a limited number of cases (**Table 4**). These findings indicate predominant reliance on conventional cytotoxic chemotherapy agents, with selective incorporation of hormonal and targeted therapies.

Table 4: Pattern of chemotherapy drug use in Sebha Oncology Centre

Frequency	Drug	Frequency	Drug	Frequency	Drug
18	5-Fluorouracil	**8**	Capecitabine	**2**	Bortezomib
16	Docetaxel	**7**	Paclitaxel	**2**	Zoledronic acid
11	Goserelin	**7**	Trastuzumab	**1**	Anastrozole
10	Carboplatin	**5**	Tamoxifen	**1**	Rituximab + gemcitabine + oxaliplatin
9	Cyclophosphamide	**4**	Etoposide	**1**	Oxaliplatin + capecitabine)
9	Dexamethazon	**3**	Adriamycin + Cyclophosphamide	**1**	Imatinib)
9	Letrozole	**3**	Bevacizumab	**1**	Vinorelbine
8	Epirubicin	**2**	Bicalutamide	**-**	**-**
8	Oxaliplatin	**2**	Thalidomide	**-**	**-**

Discussion

The current study provides an updated descriptive overview of the demographic characteristics, clinical presentations, and chemotherapy utilization patterns of cancer patients attending the SOC, the only specialized oncology facility serving southern Libya. The findings offer important regional insight into cancer epidemiology in an under-researched setting [8]. The mean age of patients in this cohort was 51.4 years, with the majority between 41 and 64 years. This reflects the peak cancer incidence during middle adulthood, consistent with international epidemiological trends demonstrating increased cancer risk with advancing age [9]. Relatively,

cancer patients in Egypt have been reported to have a slightly higher mean age (54.5 years) [10], while studies from Ethiopia documented a lower average age (45.0 years) [11]. Such variation may reflect differences in population age structure, cancer detection capacity, life expectancy, and healthcare infrastructure across countries. In Libya, the demographic transition combined with limited early screening programs may contribute to the observed age distribution. Females represented about 65.0% of the study population, resulting in an estimated female-to-male ratio of 2: 1. Breast cancer accounted for about 40.0%, explaining the predominance of female patients. Similar gender distribution has been reported in other African settings [12-14]. In Libya, breast cancer remains a major public health concern, with an estimated incidence of 18.8 per 100,000 women annually [15]. A previous Libyan study in Benghazi demonstrated that more than half of the breast cancer cases were diagnosed at advanced stages (III/IV) [16], reflecting systemic challenges in early detection. The predominance of female cases underscores the urgent need for organized breast cancer screening programs and targeted awareness campaigns in Libya. Stage II was the prevalent; Stages III and IV accounted for about 25.0% of cases. One patient (0.9%) was diagnosed at Stage I. The predominance of intermediate-stage disease suggests delayed presentation but not yet widespread late-stage detection. A significant association was identified between cancer stage at diagnosis and place of residence, highlighting notable geographic disparities.

Patients residing outside Sebha were more frequently diagnosed at Stage II compared to those within the City. This association, characterized by a small-to-moderate effect size ($V = 0.24$), may be attributed to complex patient migration patterns within the Libyan healthcare system. While rural patients are frequently diagnosed at Stage II at the SOC, many subsequently transition to higher-volume oncology hubs in northern cities of Libya for definitive treatment. This outward migration is largely necessitated by current infrastructural limitations at SOC, specifically the heavy reliance on chemotherapy and the absence of comprehensive radiotherapy and specialized surgical oncology services. Consequently, SOC often functions as a critical diagnostic gateway; however, patients frequently exit the regional care system to access the advanced multimodal therapies available in the north. Globally, early detection remains a critical determinant of cancer survival [17]. The very limited number of Stage I diagnoses in this cohort highlights deficiencies in screening infrastructure and public awareness in Libya. The concentration of Stage II diagnoses among rural residents suggests that, while early asymptomatic screening is absent, the emergence of palpable symptoms or pain may serve as a critical trigger for seeking specialized care at SOC. Strengthening early detection programs and expanding access to diagnostic services, including in rural communities, are essential to reducing disease burden and improving survival outcomes.

In this study, breast cancer was the most prevalent malignancy, followed by prostate cancer, colorectal cancer, lymphoma, and leukemia. This distribution aligns broadly with previously reported Libyan cancer patterns [4-7, 19, 20], although southern Libya has historically been underrepresented in national cancer reporting. Overall, about one-third of the patients presented with metastatic disease at diagnosis. High metastatic proportions were observed in lung and cervical cancers, consistent with international evidence that these malignancies are often detected at advanced stages due to non-specific early symptoms and limited screening access [16]. The substantial proportion of metastatic cases highlights the need for earlier detection strategies and improved diagnostic imaging capabilities at SOC. The absence of comprehensive cancer registry data in southern Libya further complicates accurate epidemiological monitoring. Chemotherapy was the dominant treatment modality, administered to most of the patients, either alone or in combination with surgery or radiotherapy. Surgery and radiotherapy were comparatively underutilized, reflecting infrastructure limitations at SOC. These findings illustrate the center's reliance on systemic therapy as the principal approach. The most frequently prescribed agents included 5-fluorouracil, docetaxel, carboplatin, cyclophosphamide, and hormonal therapies such as letrozole and tamoxifen. Targeted agents such as trastuzumab and bevacizumab were used selectively, suggesting limited but growing

incorporation of biologic therapies. This heavy reliance on cytotoxic chemotherapy underscores the importance of integrating clinical pharmacy services into oncology care. Evidence demonstrates that pharmacist-led interventions in oncology settings improve dosing accuracy, reduce medication errors, optimize toxicity management, and enhance treatment adherence [20-23]. Given the complexity and narrow therapeutic indices of many chemotherapeutic agents, structured clinical pharmacy involvement is particularly critical in resource-limited environments.

Most patients had no documented comorbidities; however, some had at least one. Although this proportion appears modest, comorbidities significantly influence cancer prognosis and therapeutic decision-making. Previous studies have shown that patients with comorbidities are less likely to receive aggressive or curative treatment and experience poorer survival outcomes [24-26]. The relatively low documented comorbidity rate may reflect underreporting in medical records rather than true absence, highlighting another area for improvement in documentation and multidisciplinary care coordination. A notable proportion of patients originated from outside Sebha, often traveling from 30 to 500 kilometers to access oncology services. Rural residence has consistently been associated with disparities in cancer incidence, stage at diagnosis, and mortality [27, 28]. Geographic barriers, limited screening facilities, transportation challenges, and scarcity of oncology-trained personnel contribute to delayed presentation [29]. The findings of the current study reinforce the urgent need for decentralized cancer screening initiatives, mobile outreach services, and strengthened referral systems in southern Libya. This study has some limitations, such as a retrospective, single-center design and small sample size, which may limit the generalizability of the findings to the broader Libyan population. The use of purposive sampling and the exclusion of some records due to incomplete documentation further increases the risk of selection bias. Crucially, the SOC often serves as an initial diagnostic point; due to infrastructure and personnel limitations, patients seek definitive care at better-equipped facilities in northern Libya or abroad. This treatment migration indicates this cohort may not fully capture the total metastatic burden or long-term outcomes in the region. Thus, it should be mentioned that implementing organized national screening programs and awareness campaigns for breast and prostate cancers, specifically targeting rural populations, can improve early-stage diagnosis. Also, integrate oncology pharmacy services to optimize the management of complex chemotherapy regimens, ensuring correct dosing and enhanced patient safety. Establish a robust, digitalized regional cancer registry to improve data documentation and support evidence-based healthcare policy in southern Libya.

Conclusion: This study highlights that Libyan patients have limited early-stage detection, substantial metastatic burden, heavy reliance on chemotherapy, and geographic inequities in access to care, as well as the need for clinical pharmacy integration. Thus, addressing these requires strengthening oncology infrastructure, establishing regional cancer registry systems, expanding screening programs, particularly for breast and prostate cancers, and integrating multidisciplinary care models.

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